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AIRPORT DELAY AND IMPROVEMENT STUDY, JOHN F. KENNEDY INTERNATIO--ETC(U)
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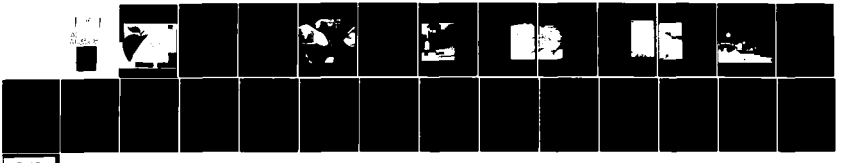

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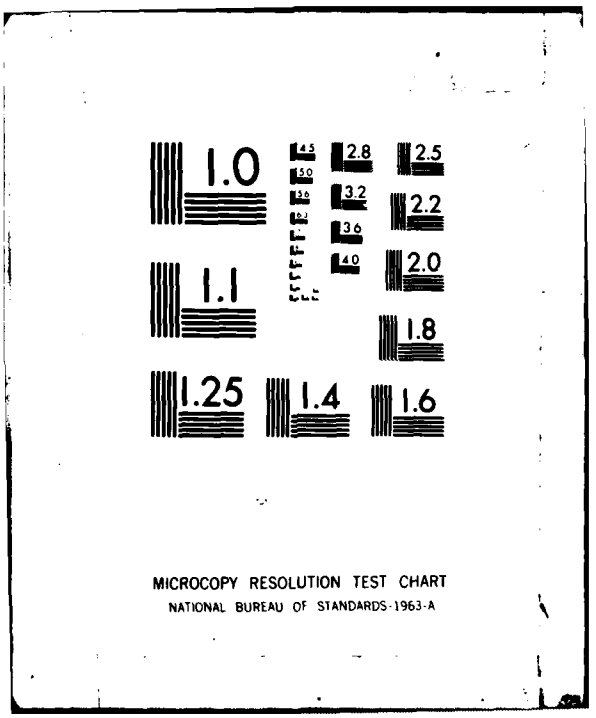
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Supporting documentation can be found in the Task Force Delay Study, JFK International Airport, and LaGuardia Airport, VOL II.

16. Abstract

This report presents the results of a detailed analysis of the New York Airports. The analysis was conducted by the New York Airport Improvement Working Group which had representatives from the airport sponsor, the Air Transport Association, the airlines serving New York, and the Federal Aviation Administration. The purpose of the analysis was to determine the causes of delay and the potential delay reduction benefits of recommended improvements. The effort was part of the Airport Improvement Program.

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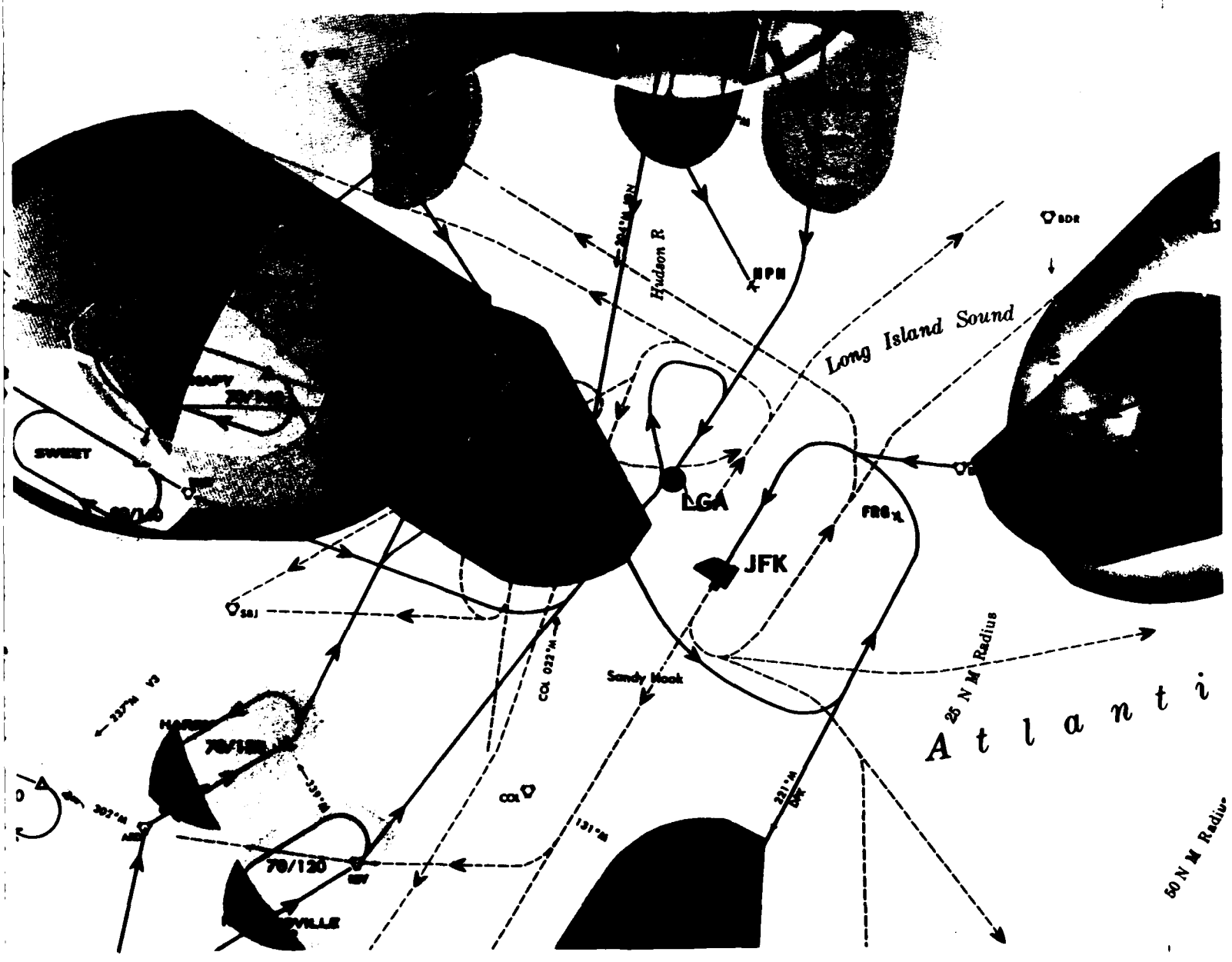
Preface

This study of air traffic delay in the New York area, its causes, and potential solutions, has identified a comprehensive program of delay reduction measures which reduce the level and costs of delay at John F. Kennedy International and LaGuardia Airports. The potential cost savings outlined for each airport are not intended to represent absolutes but rather to offer a means for comparing potential benefits which would accrue should the particular delay reduction measures be implemented.

The study was conducted by a Task Force composed of representatives of the Federal Aviation Administration, the airlines serving the two airports, the Air Transport Association, and the Port Authority of New York and New Jersey. The FAA also provided additional support from its Washington technical organization. Consultant assistance was obtained from the firm of Peat, Marwick, Mitchell & Co.

The study resulted in specific recommendations for improvements for both John F. Kennedy International and LaGuardia Airports. Some of these recommendations have already been implemented while others are currently being processed. The balance of the recommendations are offered for consideration by the appropriate agencies for early implementation.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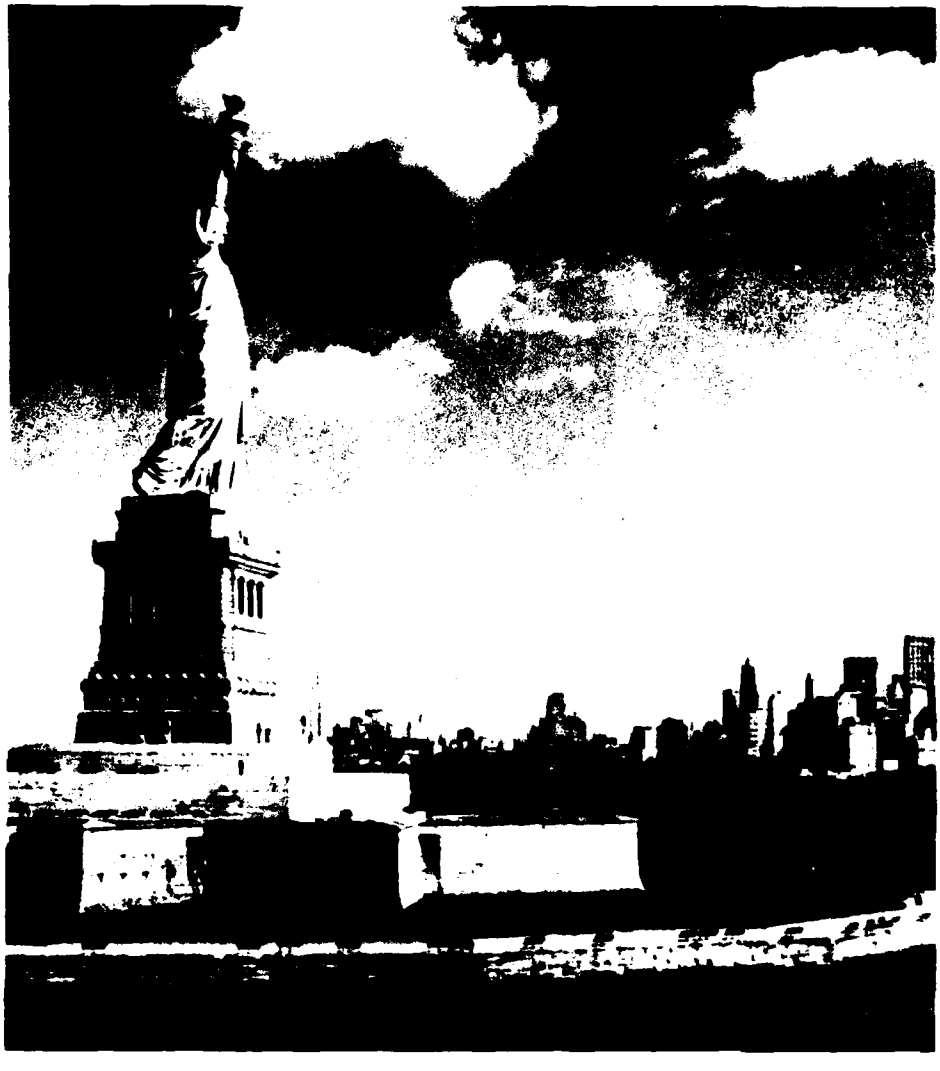


Statue of Liberty, New York Harbor

Introduction

Background

In recent years, runway capacity has steadily declined at the nation's major airports. Various restrictions, wake vortex separation standards, and other constraints, when coupled with the increases in aviation demand, have resulted in significant increases in delay and fuel consumption.

In an effort to continue providing the high level of service expected by users of the air transportation system, the aviation industry has undertaken the task of increasing to the extent possible the efficiency of use for the existing airport system.

The New York Airports Improvement Task Force was established to further that goal. The group's mission was to develop an action plan to reduce airport delays and to identify and evaluate other options for implementation which would lead to optimum airport use strategies, suggested research and development priorities, and recommendations for expenditures for runways and other airfield and navigation facilities based on the benefits to be gained.

The results of these joint recommendations were envisioned to be a coordinated series of further actions by the primary agency involved with support from the other Task Force member groups to effectively implement those actions which would reduce the delay.

John F. Kennedy International Airport

Scope

The Task Force limited its analyses to the aircraft activity, the airport, and the immediate airspace directly affecting aircraft operations at John F. Kennedy International and LaGuardia Airports. Attention was given to potential delay reductions and capacity increases offered by airfield improvements, air traffic control procedural changes, reduced separation standards, and improvements in navigation and landing aids.

Although the study analyzed several specific cases of airspace and air traffic interactions, it did not address the matter of the complexity of the airspace and the operational demands placed on it by operations at 5 air carrier and 27 general aviation airfields in the greater New York metropolitan area. This broad area of complex airspace inter-relationships was studied, in part, in the FAA Northeast Area Regional Air Traffic Study in 1980. Other portions of it will be further examined during the Newark International Airport Improvement Task Force Study scheduled for 1982.

Objectives

To guide the Task Force in their efforts, four major objectives were selected:

- Determine current airport capacity and identify causes of delay associated with terminal airspace, airfield, and apron/gate area operations.
- Identify and determine the capacity increases and delay reduction benefits of alternative air traffic procedures, navigational improvements, airfield changes, and research and development options for the immediate, short term (1982), and long term (1987).
- Determine relationships between air traffic demand and delay in the present and future time periods as an aid to establishing acceptable air traffic movement levels.
- Determine airport groundside and access growth capabilities and identify areas of potential capacity constraint.

While the fourth objective was *not considered to be within* the scope of the Task Force's technical activities, a recent report of the Tri-State Regional Planning Commission has identified ground access as one of the principal constraints affecting the capability of both airports to efficiently serve future demand for air transportation. The report stated that without local and federal governmental action to improve airport access, airport users would be severely hindered in the ground access portion of their travel.

The other three objectives have been satisfied through the work of the Task Force as outlined in this report.

LaGuardia Airport

Methodology

The New York Airports Improvement Task Force program of work consisted of two distinct phases. The initial phase, the Capacity Study, established computer analysis by the existing runway capacities and the expected increases resulting from the accomplishment of specific recommendations for short-term improvements. It also included a further evaluation of long-term airfield capacity as affected by various reductions in air traffic separation standards.

The second phase, Airfield Delay Analysis, included the analysis of delays for each of the airports studied using the results of the Capacity Study. It then analyzed the potential benefits of the various proposed changes to airport and air traffic control facilities, air traffic procedures, aircraft mix, and demand. The results were expressed in terms of delay and were produced by the airfield simulation model. The annual delay was computed by the annual delay aggregation model.

By comparing the operational cost savings possible under alternative delay reduction proposals, the Task Force was able to develop a Recommended Action Plan for implementation of improvements and other beneficial changes.

Current System Operation

Aircraft delay has been an integral part of the operation of our present system of major hub airports. Runway and land-use restrictions, airspace constraints, and environmental considerations have all become factors affecting an airfield capacity which is already overtaxed during peak periods when demand exceeds capacity.

John F. Kennedy International and LaGuardia Airports are no strangers to this phenomenon and considerable delay is generated each year as almost 3/4 of a million aircraft operations at these two facilities are joined by an additional 1.2 million operations, all contained within a confined airspace limit within a radius of 25 miles of NYC. These additional operations involve three other air carrier and 9 general aviation airports all within that same constrained airspace.

Kennedy and LaGuardia Airports alone serve the nations' seven busiest city-pair networks and fourteen others of the top twenty five while handling nearly 50 million passengers each year. Delays at these airports have a serious, detrimental impact on the travelling public.

Constraints resulting from airspace interactions between LaGuardia and Newark, and LaGuardia and Teterboro Airports, plus a similar impact resulting from operations at the myriad of small general aviation airfields in the area, produce additional congestion and delay.

These interactions are reflected in the peak period average delays shown in Figure 1 "Current Airfield Operations Analysis." They are broken down by the following weather conditions: VFR—ceilings above 2000', visibility greater than 3 nm; IFR1—ceilings between 600' and 2000', visibility between 1 nm and 3 nm; IFR2—ceilings below 600', visibility less than 1 nm. The peak period average delay is defined as the average of the arrival and departure delays during the busy 6 hour period at LaGuardia and the busy 8 hour period at Kennedy.

Departure Queue at John F. Kennedy International Airport

John F. Kennedy International Airport

Runway Use		VFR			IFR*		
Arr.	Dep.	Annual % Use	Capacity	Peak Pd. Avg Delay (Min.)	Annual % Use	Capacity	Peak Pd. Avg Delay (Min.)
31R	31L	40.7%	73	5.7	.4%	53	44.0
22R	22L	21.2%	82**	3.1	2.9%	53	44.1
13R	13L	17.6%	80***	21.2	1.7%	53	44.0
4L	4R	9.3%	73	5.4	6.2%	53	48.5

* Includes both IFR1 and IFR2 conditions
** Includes up to 15 operations on Runway 13R
*** Includes up to 12 operations on Runway 22L

La Guardia Airport

Runway Use		VFR			IFR-1			IFR-2		
Arr	Dep	Annual % Use	Capacity	Peak Pd. Avg Delay (Min.)	Annual % Use	Capacity	Peak Pd. Avg Delay (Min.)	Annual % Use	Capacity	Peak Pd Avg Delay (Min.)
22	13	23.0%	81	7.2	1.8%	62	21.8	0.9%	58	37.9
22	31	23.6%	78	*	0.4%	59	*	0.2%	46	*
31	31	17.8%	52	23.3	0.1%	52	24.4	0.0%	46	
31	4	14.7%	81	25.9	0.0%	62	—	0.0%	57	
13	13	3.7%	81	*	1.8%	62	*	1.9%	58	*
31	4	4.3%	77	20.0	0.0%	59	—	0.0%	46	
13	4	1.6%	51	*	1.2%	51	24.4	0.7%	46	*
13	13	1.2%	50	20.9	0.7%	38	43.9	0.4%	36	45.9

* Not analyzed

FIGURE 1. CURRENT AIRFIELD OPERATIONS ANALYSIS: KENNEDY AND LA GUARDIA AIRPORTS

Airfield Capacity and Demand

The results of the Capacity portion of the Task Force Study provided a numerical measure of the ability of the various runway combinations at each of the airports to process arrivals and departures at the greatest possible rate for the assumed aircraft mix. These capacities are shown in Figure 1.

The airfield simulation model used the output of the capacity model to provide an assessment of the relationship between the demand placed on the facility and the resulting delay under varying runway capacities. This was accomplished by totalling the delay to each aircraft during the simulation period.

Airfield demand, capacity, and delay are all related as Figure 2 shows. As demand increases toward capacity the demand capacity ratio approaches unity, and the delay increases.

Because capacity is fixed, the demand and its resultant delay will be the primary factors used in the discussion.

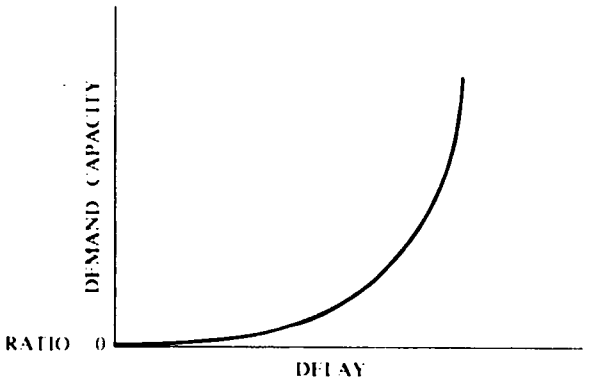


FIGURE 2. DEMAND CAPACITY AND DELAY

Peak Airfield Delays

Peak traffic demand periods were selected, and, with the constraints appropriate to the runway combinations, computations were made. The resultant average delays for peak period operations are shown in Figure 3.

The peak period method was also used to determine potential benefits between alternative improvements to the system, which are explained in the section titled, "Delay Reduction Proposals."

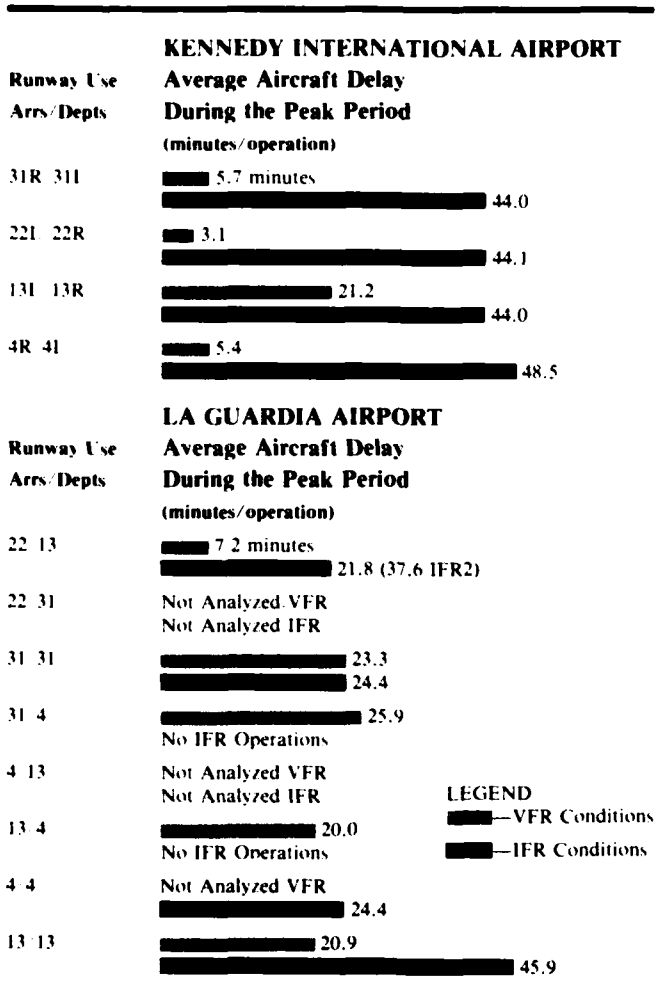


FIGURE 3. PEAK PERIOD AIRCRAFT DELAYS

Annual Airfield Delays

By extrapolating the delays incurred during the daily peak periods, an annual delay was determined. Figure 4 shows the annual delay in both hours and costs for each airport.

The seeming inconsistency of the operating costs for the two airports, is caused by the difference in fleet mix at each airport. LaGuardia, by nature, is a short haul business and general aviation airport while Kennedy is primarily long haul and international in scope. This results in costs per minute of delay of: $13.58 for arrivals and $9.02 for departures at LaGuardia and $34.84 for arrivals and $23.46 for departures at Kennedy. The amounts shown are in 1978 dollars.

KENNEDY INT'L

Hours	31,200 hours
Cost	$64.6 million

LA GUARDIA

Hours	77,400 hours
Cost	$72.0 million

Note: 1978 is the study baseline year

FIGURE 4. 1978 ANNUAL DELAY AND DELAY COSTS.

Delay Reduction Proposals

The operation of each of the airfields and the potential benefits of proposed improvements were assessed in terms of airfield capacity, demand, and airfield delays. The airfield simulation model was utilized to determine peak period aircraft delays for current operations and for operations considering proposed improvements both now and in the future.

Peak period aircraft delays have been annualized to determine the potential economic benefits of the proposed improvements, including the improved runway use strategies. The annualized delays give an indication of the efficiency of the existing system and offer a measure for comparison of the benefits of the changes proposed.

If a dollar value is attached to each minute of average annual aircraft delay, for both the current and proposed operations, several comparisons can be made to determine the relative benefits, costs, and priorities of each item. They include: 1) the annual delay cost associated with each present operation (baseline case); 2) the delay cost reduction when the baseline is compared with the proposed improvement; 3) the cost benefit when the delay reduction of the improvement is compared to the annualized implementation cost; and 4) a priority among the various proposed improvements based on a ranking of the delay reduction to be achieved.

These annualized peak period delay results can also be compared with those from the annual delay model to indicate the extent of the total delay associated with a particular existing or proposed runway operation.

The delay reduction proposals for each of the airports have been broken down by category: airfield improvement; FAA facilities and equipment (navigational aids); air traffic control procedures; and FAA engineering and development. Each recommendation has been given a ranking according to its delay reduction benefit, and placed in an action category for implementation.

Figures 5 and 6 depict the recommendations for John F. Kennedy International and LaGuardia Airports respectively, ranked according to annual delay reduction.

The action category, defined below, is shown for both airports in the final section of this report in the chapter titled, "Action Plan." The four types of actions listed are:

Implementable: Changes or improvements whose benefits have been clearly identified, on which actions can be taken, or may already be underway and which do not necessitate a major change in policy.

Major Policy Item: A change in the procedures or operational regulations of one or more of the Task Force organizations which requires a major revision to their principles.

Master Plan Study Item: A physical improvement whose delay reduction merits should be addressed while giving consideration to environmental and economic consequences beyond the scope of the Task Force Study.

Systemwide Policy Change: Improvements whose character requires that they be implemented on a nationwide or systemwide basis because of their overall scope and impact; they require detailed evaluation and research by the FAA.

JOHN F. KENNEDY INTERNATIONAL AIRPORT

Ranking of Recommendations

ITEM PROPOSED	ANNUAL DELAY REDUCTION (minutes)	ANNUAL SAVINGS (millions)
CURRENT OPERATIONS		
• Independent 31L and 31R departures in VFR conditions	298,764	$7.10
• Development of staggered arrivals for 4L and 4R (for use only until wake vortex avoidance system is in use)	151,327	$7.41
• Independent operations for 31L and 31R inIFR conditions	29,914	$1.04
FUTURE OPERATIONS		
• Interim wake vortex avoidance system (1982 demand)	2,174,940	$98.81
• Ultimate wake vortex avoidance system (1987 demand)	8,693,720	$454.57

FIGURE 5. RANKING OF RECOMMENDATIONS AT JOHN F. KENNEDY INTERNATIONAL AIRPORT

LA GUARDIA AIRPORT

Ranking of Recommendations

ITEM PROPOSED	ANNUAL DELAY REDUCTION (minutes)	ANNUAL SAVINGS (millions)
CURRENT OPERATIONS		
• Total enforcement of FAR 93 Quota System Rules during both VFR and IFR conditions	1,098,381	$14.50
• Construct phase I of west taxiway	390,939	$4.77
Install high resolution ASDE radar system	306,783	$3.72
• Relocate the R/W 13 glide slope antenna and construct a new runway exit taxiway	36,456	$.51
• Complete the second and final phase of the west taxiway network	29,544	$.38
• Relieve air traffic interaction between arrivals R/W 22 LGA and arrivals R/W 13L JFK	28,746	$.36
• Relieve air traffic interaction between LGA and TEB arrivals and departures	22,385	$.37
• Improve airspace utility for arriving R/W 13 and departing R/W 4.	17,754	$.23
FUTURE OPERATIONS		
• Interim wake vortex avoidance system (1982 demand)	354,795	$8.58
• Ultimate wake vortex avoidance system (1987 demand)	2,921,391	$71.63

FIGURE 6. RANKING OF RECOMMENDATIONS AT LA GUARDIA AIRPORT

JOHN F. KENNEDY INTERNATIONAL AIRPORT
Delay Reduction Proposals

AIRFIELD IMPROVEMENTS

No airfield improvements have been proposed for Kennedy Airport.

FAA FACILITIES AND EQUIPMENT

One recommendation for equipment is being made for Kennedy International Airport, as a part of the proposal for a 2 nm diagonal separation between alternating arrivals to runways 4L and 4R. It is the addition of a high resolution radar system to the existing air surveillance radar system. Since it is a part of the ATC proposal, the benefits of the change are discussed under that category.

AIR TRAFFIC CONTROL PROCEDURES

Three major proposals have been made in the area of air traffic control. Each of them has a potential for immediate savings if implemented. The combined savings for the three recommendations is $15.55 million annually for delay reductions totalling 480,005 minutes per year.

The delay savings are based on the 1978 aircraft demand and would increase sizably during the forecast period.

- CONDUCT INDEPENDENT DEPARTURE OPERATIONS ON RUNWAYS 31L AND 31R; **Immediate savings potential—$7,095,000 annually.**

Because of airspace constraints, concurrent operations on runways 31L and 31R result in departures only on 31L. Should these constraints be removed allowing both runways to operate with independent departure flows, an average of 4 minutes per aircraft would be saved during the peak period. This seemingly small amount equates to nearly 342,000 minutes per year, and $7,095,000.

- DEVELOP 2 NM DIAGONAL SEPARATION FOR ARRIVALS FOR 4L AND 4R (FOR USE UNTIL WAKE VORTEX AVOIDANCE SYSTEM IS IN USE): **Immediate savings potential—$7,410,000, annually.**

Normally when operating on runways 4L and 4R, departures are on 4L and arrivals are on 4R. Runway separation restricts the arrival flow if both 4L and 4R are used for arrivals. This program will reduce the delays incurred to approximately 35 minutes during the peak period, a savings of 13 minutes per aircraft operation.

Future ATC wake vortex avoidance system will render this procedure unnecessary. The new vortex avoidance separations will be lower than those possible using the 2 nm diagonal separation between approaches.

- CONDUCT INDEPENDENT OPERATIONS ON RUNWAYS 31L AND 31R IN IFR WEATHER CONDITIONS: **Immediate Savings Potential—$1,041,000 annually.**

During IFR conditions, arrivals use runway 31R and departures use 31L because of the airspace interaction and the presence of a single departure path. Should the airspace be reconfigured to allow these runways to operate independently, departures and arrivals could both be conducted on 31L and 31R. Such operations would reduce arrival and departure delays by an average of 41 minutes during the peak periods of operation.

FAA ENGINEERING AND DEVELOPMENT

Reductions in arrival and departure separations because of improved wake vortex avoidance and detection systems were evaluated for both the interim and ultimate FAA wake vortex programs. The operating conditions were taken from the FAA Engineering and Development report "Parameters of Future ATC Systems Relating to Airport Capacity Delay" FAA-EM-78-8A dated June 1978.

Experiments were run to evaluate the delay costs involved if the wake vortex avoidance system were not implemented.

- INSTITUTE INTERIM WAKE VORTEX AVOIDANCE PROGRAM BY 1982: **Future Savings Potential—$98,810,000 annually.**

The interim wake vortex system has an impact on arrivals only, reducing separation standards from 6nm to 4nm for the worst case separation requirement (a small aircraft behind a heavy aircraft). This change results in a delay reduction of 6.7 minutes per aircraft.

- DEVELOP ULTIMATE WAKE VORTEX AVOIDANCE PROGRAM BY 1987: **Future Savings Potential—$454,570,000 annually.**

The ultimate wake vortex avoidance and detection program has an impact on both arrivals and departures. It reduces the arrival separation requirements to 3nm for the worst case situation of a small aircraft behind a heavy jet. The departure separation requirements drop from 2 minutes to 1 minute for all mix combinations. This series of changes results in an average saving of 26.3 minutes per operation.

1982	
Without Interim System	10,831,426 minutes
With Interim System	8,656,486 minutes
1987	
Without Ultimate System	11,875,640 minutes
With Ultimate System	3,181,920 minutes

FIGURE 7. WAKE VORTEX AVOIDANCE SYSTEM BENEFITS FOR KENNEDY AIRPORT

LA GUARDIA AIRPORT
Delay Reduction Proposals

AIRFIELD IMPROVEMENTS

Three taxiway construction projects were proposed for LaGuardia Airport. Two of the three have potential for some additional savings in the future, while the third project, the Initial Phase of the West Taxiway Network, has been completed, and benefits are already being realized.

Overall delay savings for the three projects is estimated at $6.8 million a year and a corresponding delay reduction of 603,000 minutes.

- CONSTRUCT AN EXIT TAXIWAY FOR RUNWAY 13: **Immediate Savings Potential—$512,000 annually.**

This project is combined with the relocation of the Runway 13 glide-slope project. Once the glide-slope is moved, runway occupancy becomes more critical than it is today. The additional exit taxiway will permit aircraft to exit from the runway sooner permitting a reduced separation between arrivals. The benefits of this proposal are a part of the same benefits achievable from the glide slope relocation and cannot be considered separate and apart from it. The reduction in delay would approximate 32 minutes per aircraft during the peak period, in IFR conditions when arriving and departing on Runway 13.

- CONSTRUCT PHASE ONE OF THE LA GUARDIA AIRPORT WEST TAXIWAY NETWORK: **Immediate Savings Potential—$4,773,000 annually.**

This taxiway development, which has been recently completed, was provided to increase the airport's capacity to store aircraft away from the central terminal area, and to create separate routes directly to Runways 4 and 13 for each of the standard departure procedures. This network of taxiways is beneficial for arriving on Runway 22, and departing on Runway 13 and for arriving and departing Runway 4. Average delay savings associated with this project are estimated to be more than 66 minutes for each Runway 4 operation, and 26 minutes for each Runway 22-13 operation, when the airport has been saturated by departures, thereby shutting off the arrival flow.

- COMPLETE THE SECOND AND FINAL PHASE OF THE LA GUARDIA AIRPORT WEST TAXIWAY NETWORK: **Future Savings Potential—$375,000 annually.**

Completion of the west taxiway network involves extension of one taxiway and construction of a third parallel taxiway. This construction will add additional storage capacity on the westside of the airport for aircraft. It will reduce the delay to each operation on either runway combination by a maximum of 3 minutes. This represents an additional savings of 8% over that obtained in phase 1.

FAA FACILITIES AND EQUIPMENT

$5.22 million in savings are proposed in the two F&E projects recommended as a result of the Task Force study. The more beneficial of the two is the installation of an ASDE which, although evaluated for a specific runway use combination, can benefit all operations at the airport. The second project affects only landings on Runway 13 and is therefore less beneficial.

Overall delay savings from the two projects will be 462,500 minutes annually or 1.3 minutes per operation throughout the year.

- RELOCATE THE RUNWAY 13 GLIDESLOPE ANTENNA: **Immediate savings potential—(See Runway 13 Exit Taxiway discussion under Airfield Improvements).**

The location of the glide-slope antenna on Runway 13 is such that during mixed operations on the runway (both arrivals and departures), increased separation standard must be imposed to insure that departures ap-

proaching the runway end do not interfere with the glide-slope signal of an approaching aircraft. By relocating the glide-slope a considerable reduction in separation standards could occur with an associated delay reduction. Such a reduction would be approximately 36 minutes per arrival, with the departure delay increasing by 3.5 minutes. Overall, a delay savings of approximately 32 minutes per aircraft during the peak period would be enjoyed were takeoffs and landings are conducted on Runway 13.

- INSTALL HIGH RESOLUTION AIRPORT SURFACE DETECTION EQUIPMENT (ASDE) RADAR: **Immediate Savings Potential—$356,000 annually.**

During extremely low visibility conditions, the air traffic controller cannot see the intersection of Runways 4-22 and 13-31. He must be assured that the aircraft landing on Runway 22 has crossed and cleared the departure runway prior to releasing the departure. The ASDE will enable the controller to release the departure in IFR 2 conditions without waiting for the arrival to come into view. This installation could save nearly 16 minutes per operation during the peak period when Runway 22 is used for landing and Runway 13 for takeoff. This is estimated to occur .9% of the time. If the benefits of the ASDE can be expanded during use of other runway combinations in IFR 2 conditions, a potential $3.7 million savings could be obtained.

AIR TRAFFIC CONTROL PROCEDURES

Four proposals have been made which involve modifications to the air traffic control operation at LaGuardia. Three of them are airspace interaction problems which must be addressed in conjunction with the other ATC facility involved. The remaining proposal must be addressed immediately by the FAA and the Port Authority of New York and New Jersey. Involved are policy revisions concerning the implementation of quotas in both VFR and IFR conditions. These are critical issues which have a potential payback of over $14 million a year and a delay reduction of more than 1.1 million minutes, annually.

Overall, the ATC proposals offer a delay reduction potential of 1.2 million minutes and a cost savings of nearly $16 million annually.

- RELIEVE AIR TRAFFIC INTERACTION BETWEEN ARRIVALS R/W 22 AT LA GUARDIA AND ARRIVALS R/W 13L AT KENNEDY AIRPORT: **Immediate Savings Potential—$357,000 annually.**

When Kennedy Airport is required to use the Runway 13L ILS approach, LaGuardia is prohibited from using the Runway 22 ILS because of airspace interactions between the missed approach and the JFK ILS traffic. The development of a procedure for the Runway 22 missed approach to eliminate this airspace conflict would permit dual runway use at LaGuardia when Kennedy is using the Runway 13L ILS. This proposal would save 35.5 minutes per arrival and 12.4 minutes per departure during the peak operating periods of the day.

- RELIEVE AIR TRAFFIC INTERACTION BETWEEN LA GUARDIA AND TETERBORO ARRIVALS AND DEPARTURES: **Immediate Savings Potential—$365,000 annually.**

Interaction between traffic landing Runway 13 at LaGuardia and operations at Teterboro Airport creates considerable delay at both airports. This situation becomes critical when LGA is forced to use the Runway 13 ILS; at that time a one-for-one traffic flow between the two airports must be conducted. This results in a 15 miles in trail arrival separation at LGA. Elimination of this traffic interaction will reduce peak period arrival delays by 32.5 minutes per aircraft. It does increase the departure delays by 12 minutes per aircraft, however an overall savings does occur.

- TOTALLY ENFORCE FAR PART 93 SUBPART K—HIGH DENSITY TRAFFIC AIRPORTS RULE FOR LA GUARDIA AIRPORT: **Immediate Savings Potential—$14,497,000 annually.**

FAR 93, Subpart K, High Density Traffic Airports, limits the number of IFR operations which can operate into or out of LaGuardia Airport each hour. This limitation is broken down by category of aircraft as follows: Air Carrier 48; Air Taxi 6; and Others 6. These quotas have not, for various reasons, been enforced for all categories. The result has been additional delay and congestion for all of the users of the airport.

VFR operations can be accommodated at the airport during visual weather conditions through the use of a VFR reservation granted by ATC, whenever the aircraft can be accommodated without significant additional delay to the operations allocated for the airport. This section of the regulation has also not been enforced, allowing VFR traffic unimpeded access to LaGuardia Airport.

Total compliance with both facets of this regulation will reduce the aircraft demand and, therefore, the congestion at LaGuardia Airport. The IFR portion of the enforcement would result in savings of $3.7 million annually and the VFR portion a savings of $11 million annually.

- IMPROVE AIRSPACE UTILITY FOR ARRIVING RUNWAY 13 AND DEPARTING RUNWAY 4: **Immediate Savings Potential—$232,210 annually.**

In instrument meteorological conditions, arrivals to Runway 13 interact with the departures on Runway 4, preventing the unconstrained use of this combination in busy periods. Resolution of the interaction would allow these flows of traffic to be less constrained, resulting in lower departure delays for Runway 4 as well as lower arrival delays for Runway 13. The average delay reduction per aircraft would be 14.8 minutes per operation during the peak period of the day.

FAA ENGINEERING AND DEVELOPMENT

Reductions in arrival and departure separations because of improved wake vortex avoidance and detection systems were evaluated for both and interim and ultimate FAA wake vortex programs. The operating conditions evaluated were taken from the FAA Engineering and Development report "Parameters of Future Air Traffic Control Systems Relating to Airport Capacity and Delay", FAA-Em-78-8A, dated June 1978.

These experiments were run to evaluate the delay costs involved if the wake vortex avoidance system is not implemented or if it is delayed.

- INSTITUTE INTERIM WAKE VORTEX AVOIDANCE PROGRAM BY 1982: **Future Savings Potential $8,583,429 Annually.**

The interim wake vortex system has an impact on arrivals only, reducing separation standards from 6nm to 4nm for the worst case separation requirement (a small aircraft behind a heavy jet). Even though this change is small, it results in a delay reduction of 1.8 minutes per aircraft.

- DEVELOP ULTIMATE WAKE VORTEX AVOIDANCE PROGRAM BY 1987: **Future Savings Potential—$71,636,488 annually.**

The ultimate wake vortex avoidance program has an impact on both arrivals and departures. It reduces the arrival separation requirements to 3nm for the worst case situation of a small jet. The departure separation requirements drop from 2 minutes to 1 minute for all mix combinations. This series of changes results in an average savings of 8.6 minutes per operation.

LaGuardia Airport Air Traffic Sensitivity Analyses

Variations in the mix of aircraft types using LaGuardia Airport strongly influence the amount of operating delay incurred. A number of sensitivity tests were run to determine the impact of increased general aviation operations on delay, and the impact of increased wide-bodied aircraft usage on delay.

GENERAL AVIATION OPERATIONS ANALYSIS

Longitudinal separation requirements play a major role in creating runway arrival and departure delay. Uniform operating speed, if achievable, would help to reduce such delays by standardizing the spacing requirements, thus minimizing separation variations. Consequently, the mixing of fast (air carrier and high performance business jets) and slow (air taxi, commuter, and private propeller-driven planes) aircraft types results in less than optimum aircraft spacing. This results in a reduction in the operating rate, and a corresponding increase in delay. LaGuardia Airport's air traffic is approximately 70% high performance jets and 30% propeller-driven, low performance aircraft, with much slower approach and departure airspeeds. Several simulation experiments were conducted to determine the effect upon delays by altering the general aviation and air carrier aircraft mix. These experiments included comparisons with and without the improved ATC separation standards.

The forecasts for 1982 and 1987 both assume a decrease in total operations by reducing general aviation traffic from 25% of the total to 15% of the total. This is a reduction from 102 to 55 general aviation operations during the peak 6-hour operating period of the day.

If this reduction does not occur, general aviation will remain as 25% of the total operation. The resulting 1982 delays would increase by 35,000 minutes, for an added cost of $633,000 annually. This is an average 10-minute increase in arrival delay during the peak period in IFR conditions and would be approximately the same, with or without the use of the interim Wake Vortex Avoidance System.

The 1987 delays associated with this higher level of general aviation activity will vary considerably, depending on the availability of the ultimate Wake Vortex Avoidance System. Without the Wake Vortex Avoidance System, an increased annual delay of 54,500 minutes will occur at an added cost of $1,046,103. This is an additional 16 minutes of average ar-

rival delay in IFR-1 conditions during the peak 6-hour period of the day.

Incorporating the ultimate Wake Vortex Avoidance System into the analysis, the increased general aviation activity adds 5,733 additional minutes of delay at a cost of $95,578 annually. Because of the overall delay reduction due to Wake Vortex Avoidance System, the general aviation increase in average arrival delay during the peak period is only 1.4 minutes in IFR-1 conditions.

These comparisons of the level of general aviation operations are shown in Figure 8.

Operations Analysis Wide-Bodied Aircraft

Increasing the proportion of wide-bodied aircraft in the LaGuardia fleet mix has an appreciable effect on the operating rate and on delay because of the increased separation which must be provided between aircraft. The air carrier forecast used in the study assumed a very gradual increase in the number of wide-bodied aircraft operations. In the 6-hour peak operating period, wide-bodied aircraft use increases from 3.1% in 1978 to 6% in 1987.

The Port Authority's air carrier forecast, on the other hand, called for fewer total operations, but a greater proportion of wide-bodied aircraft, 9.5% in 1982 and 32.9% in 1987. Simulation experiments were performed to determine the influence on delay of increases in the use of wide-bodied aircraft in the LaGuardia fleet, assuming the same level of enplanements for each forecast.

The results of the 1982 sensitivity analysis showed an average reduction in arrival delay of .5 minutes in the peak period with IFR-1 conditions. With this increase in wide-bodied aircraft operations, the annual savings is only 3,900 minutes.

For 1987, the 27% increase in wide-bodied aircraft use is accompanied by an overall decrease in operations of 14%. These two factors combine to show a delay reduction in IFR-1 weather conditions, arriving Runway 22 and departing Runway 13 during the peak period. Annually, this is 6,500 minutes of delay savings. This reduction in delay can be attributed to the fewer numbers of operations which results from the greater passenger carrying capability of the wide bodied aircraft. These delays are shown in Figure 9.

1982	
INTERIM WAKE VORTEX SYSTEM	
Forecast G. A Demand	49,864 minutes*
Increased G. A Demand	84,979 minutes*
NO WAKE VORTEX SYSTEM	
Forecast G. A Demand	56,260 minutes*
Increased G. A Demand	92,228 minutes*
1987	
ULTIMATE WAKE VORTEX SYSTEM	
Forecast G. A Demand	11,312 minutes*
Increased G. A Demand	17,045 minutes*
NO WAKE VORTEX SYSTEM	
Forecast G. A Demand	63,904 minutes*
Increased G. A Demand	118,448 minutes*

*For arrivals on R. W. 22 and departures on R. W. 13 in IFR-1 conditions.

FIGURE 8. AIR TRAFFIC DELAY SENSITIVITY TO VARIATIONS IN GENERAL AVIATION ACTIVITY AT LA GUARDIA AIRPORT.

1982	
Forecast W. B Demand	47,447 minutes*
Increased W. B Demand	43,894 minutes*
1987	
Forecast W. B Demand	7,582 minutes*
Increased W. B Demand	2,404 minutes*

*Annual delay for arrivals on R. W. 22 and departures on R. W. 13 in IFR-1 conditions.

FIGURE 9. AIR TRAFFIC DELAY SENSITIVITY TO VARIATIONS IN WIDE-BODIED (W. B) AIRCRAFT USE AT LA GUARDIA AIRPORT

Demand-Delay Relationships

Numerous factors affect the capacity and, therefore, the amount of delay encountered at an airport. Some of these factors can be adjusted by making airfield improvements, by adding new navigational aids and equipment, or by revisions to air traffic procedures. The previous chapter, "Delay Reduction Proposals," analyzed a number of such individual recommendations for John F. Kennedy International and LaGuardia Airports, and listed delay reduction benefits of each one.

This chapter continues that evaluation on an annualized basis showing the relationships between the actual demand and the resulting delay for both present and future time frames, of the proposed improvements as well as the baseline cases. This permits an analysis of the overall benefits of the future ATC system with its wake vortex avoidance system along with the airfield improvements and air traffic changes for individual runway combinations.

Airfield Demand

Figures 10 and 11 illustrate the projected increases in annual demand for both Kennedy International and LaGuardia Airports. These increases are reflected in higher peak hour, peak period, and peak month figures, which are also shown.

Airfield Delay

Airfield delay is the excess travel time taken by an aircraft moving from the departure terminal to the runway and to the departure fix; or by an arriving aircraft from the approach fix to the runway and on to the arrival terminal. The average annual delays associated with this aircraft movement involve many factors including airfield physical layout, air traffic control procedures, aircraft characteristics, airfield capacity, system demand, and weather.

Congestion results whenever the volume of aircraft operations at an airport approaches the airfield capacity. Aircraft delays during congested periods are very high and consequently, with frequent congested periods, the average aircraft annual delay is also very high.

ANNUAL DEMAND LEVEL	
1978	323,904
1982	326,450
1987	330,680
AVERAGE DAY OF PEAK MONTH DEMAND LEVEL	
1978	956
1982	1003
1987	1016
PEAK HOUR OF AVERAGE DAY PEAK MONTH DEMAND LEVEL	
1978	81
1982	102
1987	103

FIGURE 10. KENNEDY INTERNATIONAL AIRPORT DEMAND LEVELS

ANNUAL DEMAND LEVELS	
1978	326,555
1982	327,400
1987	337,700
AVERAGE DAY OF THE PEAK MONTH DEMAND LEVELS	
1978	942
1982	958
1987	988
PEAK HOUR OF AVERAGE DAY PEAK MONTH DEMAND LEVELS	
1978	79
1982	70
1987	72

FIGURE 11. LA GUARDIA AIRPORT DEMAND LEVELS

Figure 12 depicts the effects of future operations (demand and aircraft mix) assuming 1978 conditions, specifically no airport improvements and no reductions in separation criteria. It represents effectively, the do nothing case and illustrates a 33.0% increase in the hours of annual delay from 1978 to 1987.

		1978	1982	1987
Kennedy Int'l	Hours	31,200	33,070	42,100
	Cost	$64.6 million	$66.9 million	$100.3 million
LaGuardia	Hours	77,400	78,400	100,180
	Cost	$87.0 million	$87.0 million	$113.0 million

FIGURE 12. ANNUAL DELAY AND DELAY COSTS

Delay Savings

If the near-term airfield and procedural improvements, and the ATC reduced wake vortex systems, as described in this and the previous chapter, are implemented, the annual delays would be significantly reduced. The resulting annual delay cost savings in 1987 for Kennedy International Airport would be $469 million while the reduction at LaGuardia Airport would be $96 million.

JOHN F. KENNEDY INTERNATIONAL RECOMMENDED AIRPORT ACTION PLAN ITEMS

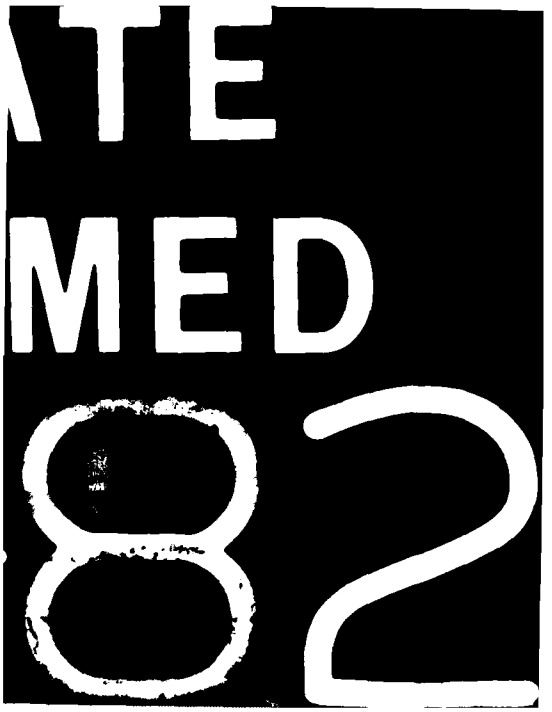
IMPROVEMENT	TYPE OF ACTION*	TIME FRAME	RESPONSIBLE AGENCY
• Airfield Improvements:			
None			
• Facilities and Equipment Improvements:			
Install high resolution Air Surveillance Radar	Implementable	Short Range	FAA
• Air Traffic Control System Improvements:			
Develop staggered approaches to R4L and R4R	Implementable	Short Range	FAA
Develop independent departure flows for R31L and 31R, in VFR	Implementable	Short Range	FAA
Develop independent operations for R31L and R31R, in IFR	Implementable	Intermediate	FAA
• Engineering, Research, and Development Items:			
Expedite development and use of interim wake vortex avoidance system	Systemswide Policy Change	Intermediate	FAA
Develop and implement full reduction wake vortex avoidance system	Systemwide Policy Change	Long Range	FAA

*Definition of types of action: **Implementable**—changes or improvements whose benefits have been clearly identified, on which action may already be underway and which do not necessitate a major policy change by any of the participating Task Force organizations. **Major Policy Item**—a change in procedure or operational regulation which requires a major revision to the policy of one of the Task Force organizations. **Master Plan Study Item**—Physical improvements whose delay reduction merits should be addressed giving consideration to environmental and economic consequences beyond the Task Force scope. **Systemwide Policy Change**—Improvements whose character require that they be implemented systemwide at the same time because of their overall scope of application; they require detailed evaluation and research by the Federal Aviation Administration.

LAGUARDIA AIRPORT RECOMMENDED ACTION PLAN ITEMS

IMPROVEMENT	TYPE OF ACTION*	TIME FRAME	RESPONSIBLE AGENCY
• Airfield Improvements:			
Construct new exit taxiway for landing R13	Master Plan	Short Range	PANYNJ
Construct taxiway network west of R4-22, Phase I	Implementable	Completed	PANYNJ
Construct taxiway network west of R4-22, Phase II	Master Plan	Long Range	PANYNJ
•Facilities and Equipment Improvements:			
Install state of art ASDE Radar	Implementable	Intermediate	FAA
Relocate the glide slope for R13	Implementable	Short Range	FAA
• Air Traffic Control System Improvements:			
Relieve airspace interaction between LGA and JFK for A22 at LGA with A13L at JFK	Major Policy	Intermediate	FAA
Relieve airspace interaction between LGA and TEB for various operational configurations	Major Policy	Intermediate	FAA
Relieve airspace constraints affecting LGA for Arrivals R13 and Departures 4R	Major Policy	Intermediate	FAA
Totally enforce FAR 93 Subpart K—High density traffic airports rule for LaGuardia Airport	Implementable	Short Range	FAA
• Engineering, Research, and Development Items:			
Expedite development of interim wake vortex avoidance system	Systemwide Policy Change	Intermediate	FAA
Develop and implement ultimate wake vortex avoidance system	Systemwide Policy Change	Long Range	FAA

*Definition of types of action: **Implementable**—changes or improvements whose benefits have been clearly identified, on which action may already be underway and which do not necessitate a major policy change by any of the participating Task Force organizations. **Major Policy Item**—a change in procedure or operational regulation which requires a major revision to the policy of one of the Task Force organizations. **Master Plan Study Item**—Physical improvements whose delay reduction merits should be addressed giving consideration to environmental and economic consequences beyond the Task Force scope. **Systemwide Policy Change**—Improvements whose character require that they be implemented systemwide at the same time because of their overall scope of application; they require detailed evaluation and research by the Federal Aviation Administration.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